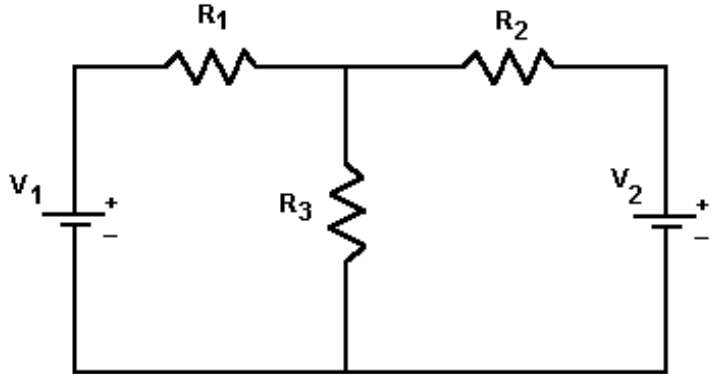


"NOT A HOMEWORK PROBLEM"

This circuit cannot be reduced by series/parallel network reduction. Find the currents going through each of the resistors, i_1 , i_2 and i_3 , given the values for the R 's and V 's as shown.

$$R_1 = 10.0 \, \Omega \quad R_2 = 20.0 \, \Omega \quad R_3 = 30.0 \, \Omega \quad V_1 = 6.00 \, V \quad V_2 = 4.00 \, V$$



$$\begin{aligned} i_1 + i_2 &= i_3 \\ V_1 - i_1 R_1 - i_3 R_3 &= 0 \\ V_2 - i_2 R_2 - i_3 R_3 &= 0 \end{aligned}$$

Our Three Equations (1 junction, 2 loops)

$$\begin{aligned} V_1 - i_1 R_1 - (i_1 + i_2) R_3 &= 0 \\ V_1 - i_1 R_1 - i_1 R_3 - i_2 R_3 &= 0 \\ V_1 - i_1 (R_1 + R_3) - i_2 R_3 &= 0 \\ V_1 - i_1 (R_1 + R_3) &= i_2 R_3 \\ i_2 &= \frac{V_1 - i_1 (R_1 + R_3)}{R_3} \\ &= \frac{6.00V - i_1 (40.0\Omega)}{30.0\Omega} \\ &= \frac{6.00V}{30.0\Omega} - 1.333i_1 \end{aligned}$$

$$\begin{aligned} V_2 - i_2 R_2 - (i_1 + i_2) R_3 &= 0 \\ V_2 - i_2 R_2 - i_2 R_3 - i_1 R_3 &= 0 \\ V_2 - i_2 (R_2 + R_3) - i_1 R_3 &= 0 \\ V_2 - \left(\frac{6.00V}{30.0\Omega} - 1.333i_1 \right) (50.0\Omega) - i_1 R_3 &= 0 \\ 4.00V - 6.00V \left(\frac{50.0\Omega}{30.0\Omega} \right) + 1.333i_1 (50.0\Omega) - i_1 (30.0\Omega) &= 0 \\ 4.00V - 10.00V + i_1 (66.65\Omega - 30.0\Omega) &= 0 \\ -6.00V + i_1 (36.65\Omega) &= 0 \end{aligned}$$

$$\begin{aligned} -6.00V + i_1 (36.65\Omega) &= 0 \\ +i_1 (36.65\Omega) &= 6.00V \\ i_1 &= \frac{6.00V}{36.65\Omega} = 0.1637 \, A \\ i_2 &= \frac{6.00V}{30.0\Omega} - 1.333i_1 \\ &= 0.2000 \, A - (1.333)(0.1637 \, A) \\ &= -0.01821 \, A \\ i_3 &= i_1 + i_2 = 0.1637 \, A - 0.01821 \, A \\ &= 0.1455 \, A \end{aligned}$$

$$\begin{aligned} V_1 - i_1 R_1 - i_3 R_3 &= 0 \\ 6.00V - (0.1637 \, A)(10.0\Omega) - (0.1455 \, A)(30.0\Omega) &= -0.002V \\ V_2 - i_2 R_2 - i_3 R_3 &= 0 \\ 4.00V - (-0.01821 \, A)(20.0\Omega) - (0.1455 \, A)(30.0\Omega) &= -0.0008V \end{aligned}$$